Example 2: Lateral load case

Circular drilled shafts 2.5 feet in diameter are designed to support the pier of the bridge for the north-west corner of the intersection of I-40 West and North Carolina Highway 55 in Durham. The drilled shaft, with steel casing, was embedded in weathered rock layer with 72% to 100% of RQD.

Similar to the axial loading case, the ratio of dead load and live load (Q_D/Q_L) is assumed to 1.5, and unfactored design load is given as 150 kips per shaft. In ASD, the required ultimate pile capacity is 375 kips at FS=2.5, and the required length of the drilled shaft is 13.3 feet, as shown in Figure 156.

It is assumed that the resistance factor is 0.4 at the factor of safety=2.5 and the target reliability index=2.5 for the Geologic model. According to load factors for dead load and live load from AASHTO (2006), the resistance of the drilled shaft can be expressed by Equation 37.

Equation 37
$$\phi R = 0.4R = \sum \gamma_i Q_i = 1.25 Q_D + 1.75 Q_L$$

Equation 37 can be rewritten as Equation 38:

Equation 38
$$0.4R = 1.25 \cdot (0.6Q) + 1.75 \cdot (0.4Q) = 1.45Q$$

From the Equation 38, the resistance (R) of LRFD is 544 kips (=150 kips × 1.45 / 0.4), which is correspond to FS=3.63. However, from the MultiPier analyses, the required length for to satisfy a 0.5 inch displacement criterion is 26.2 feet, which is 12.9 feet longer than ASD.